United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine

Ralstonia solanacearum race 3 biovar 2: Case Study

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2003 CAPS Annual Meeting

Why is the pathogen of concern?

Ralstonia solanacearum **race 3 biovar 2 (Rsr3b2) is one of the most destructive plant pathogenic bacteria worldwide.**

Quarantine Pest

United States
Canada
European Union

Select Agent

US regulations- list of “select agents and toxins”

- Agricultural Bioterrorism Protection Act

Races and Biovars

Race	Host Range	Country	Biovar
1	Wide	Asia, Australia, **Americas**	3, 4, 1
2	Banana, Musa spp	Caribbean, Brazil, Philippines	1
3	**Solanaceae, Geraniums, other**	**Worldwide, not US or Canada**	**2**
4	Ginger	Asia	3, 4
5	Mulberry	China	5

Rsr3b2 in Potatoes

- 1.5M ha in 80 countries, $950M losses annually (CIP)
- Sporadic outbreaks in 9 of 15 EU Member States since 1989

Source: J. Elphinstone, CSL,UK

Rsr1b1 in Tomatoes

Source: J. Jones, Univ. of Florida

Symptoms

Symptoms of a geranium with Southern wilt caused by Rsr3b2 may be confused with those of bacterial blight caused by *Xanthomonas campestris* pv. *pelargonii* (Xcp).

Symptoms

Rsr3b2	Xcp
No leaf spots	Can cause leaf spots
V-shaped chlorotic or necrotic areas on leaves	
Yellowing, wilting, browning, i.e. of lower leaves	Yellowing, wilting, browning of leaves
Bacterial streaming from cut vascular tissue	No streaming
Vascular discoloration of stem, roots may turn brown	Vascular discoloration less pronounced or absent, roots remain white

Ralstonia solanacearum race 3 biovar 2

Source: WI Dep. Ag., Trade & Consumer Protection

Upward reaching

Source: J. Cruse, WI SPHD

Subtle symptoms

Source: J. Cruse, WI SPHD

Early grey leaf symptom

Source: J. Cruse, WI SPHD

Xanthomonas campestris pv. pelargonii

Source: M. Daughtrey, Cornell Univ.



Regulatory Procedures





New Pest Advisory Group (NPAG) Teleconferences, 2001

Triggered by detections of Rsr3b2 in geraniums in NJ, NY, PA, SD and WI greenhouses in 1999 (eradicated).

Epidemiology

Routes of spread:

- Soil
- Contaminated water
- Equipment
- Personnel
- Transplanting infected plants

Epidemiology

Rsr3b2 is not known to spread:

- Through the air
- From plant to plant by water splashing from leaf surfaces

2003 Rsr3b2 US Eradication

2003 Rsr3b2 US Eradication

24 January- Goldsmith Plants notified APHIS

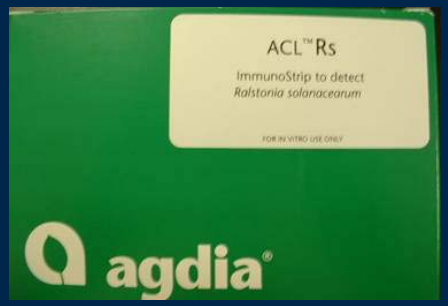
- 5 US customers notified Goldsmith of wilt in rooted geranium cuttings
- traced to 7 Kenya stock plants from 500,000

1/24	1/31	2/7	2/14	2/21	2/28	3/7	3/14	3/21	3/28	4/4	4/11	4/18	4/25	5/2	5/9	5/16	5/23
1	7	13	20	27	34	43	50	57	64	70	77	84	91	98	105	112	119

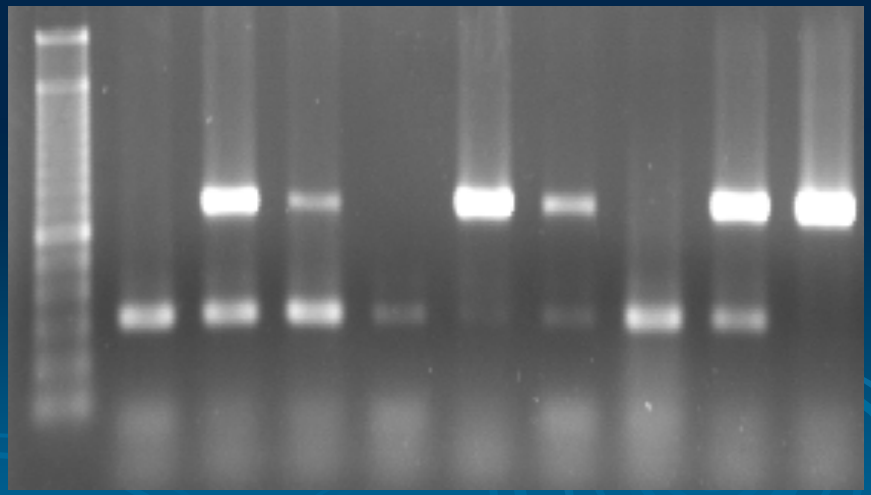
Friday to Friday timeline

Diagnostics

Serological- species level



PCR- Race and biovar



2003 Rsr3b2 US Eradication

13 February- APHIS visited Goldsmith's production farm in Kenya (1st visit in 2002)

2003 Rsr3b2 US Eradication

14 February- APHIS confirmed Rsr3b2 in geraniums in 4 greenhouses in IN, IL, WI.

- Plants, cuttings, and vegetative propagules of *Pelargonium* spp from Kenya prohibited

1/24	1/31	2/7	2/14	2/21	2/28	3/7	3/14	3/21	3/28	4/4	4/11	4/18	4/25	5/2	5/9	5/16	5/23
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2003 Rsr3b2 US Eradication

27 February- Action Plan

1/24	1/31	2/7	2/14	2/21	2/28	3/7	3/14	3/21	3/28	4/4	4/11	4/18	4/25	5/2	5/9	5/16	5/23
1	7	13	20	27	34	43	50	57	64	70	77	84	91	98	105	112	119

2003 Rsr3b2 US Eradication

19 March- WTO Notice, phytosanitary requirements

1/24	1/31	2/7	2/14	2/21	2/28	3/7	3/14	3/21	3/28	4/4	4/11	4/18	4/25	5/2	5/9	5/16	5/23
1	7	13	20	27	34	43	50	57	64	70	77	84	91	98	105	112	119

2003 Rsr3b2 US Eradication

16 May, Interim Rule- 7 CFR 319

1/24	1/31	2/7	2/14	2/21	2/28	3/7	3/14	3/21	3/28	4/4	4/11	4/18	4/25	5/2	5/9	5/16	5/23
1	7	13	20	27	34	43	50	57	64	70	77	84	91	98	105	112	119

2003 Rsr3b2 US Eradication

21 May- Eradication Concluded

- 127 positive facilities (27 States)
- 921 facilities released
- 143 control actions
- >2M plants destroyed
  - (1.9M geraniums)

1/24	1/31	2/7	2/14	2/21	2/28	3/7	3/14	3/21	3/28	4/4	4/11	4/18	4/25	5/2	5/9	5/16	5/23
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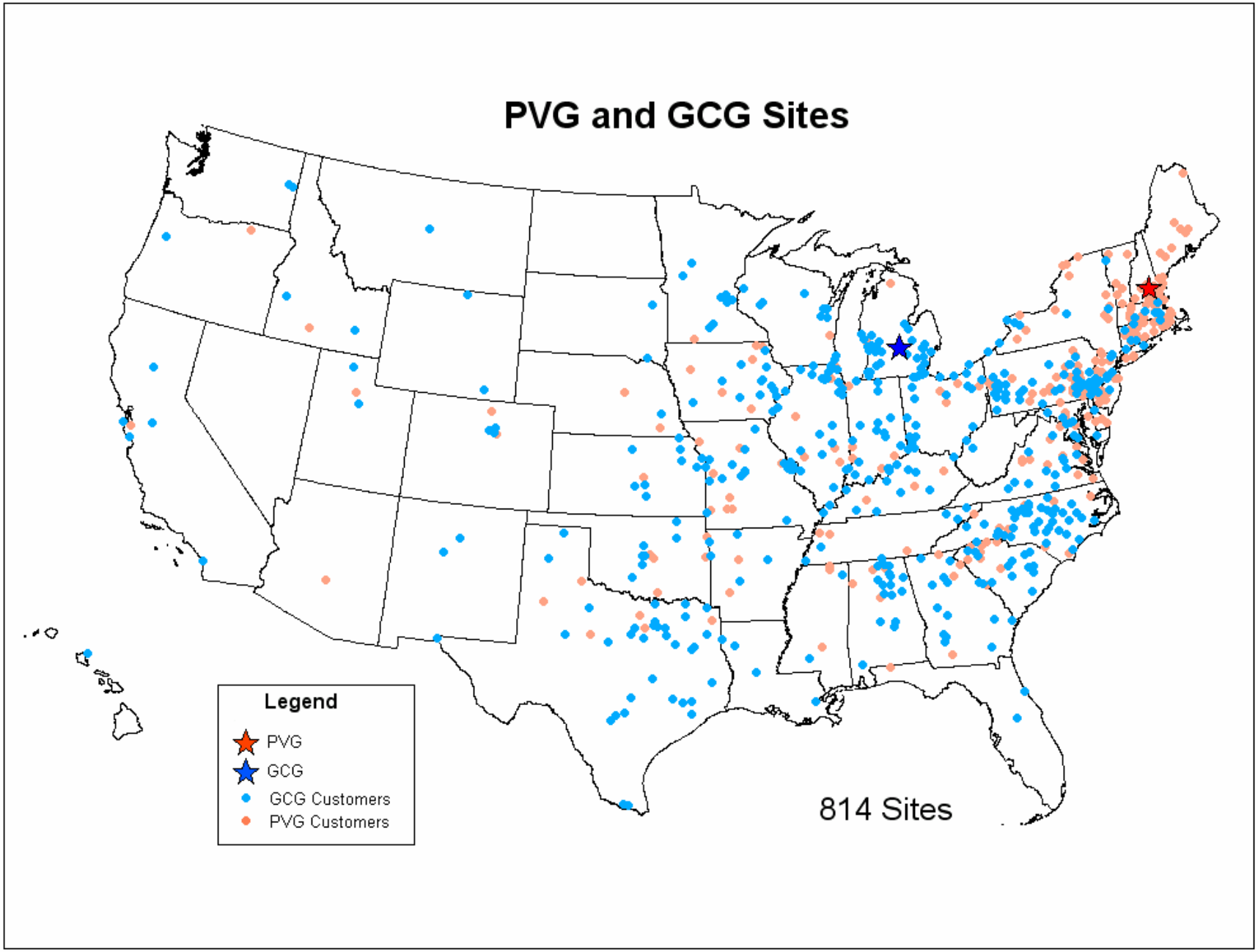
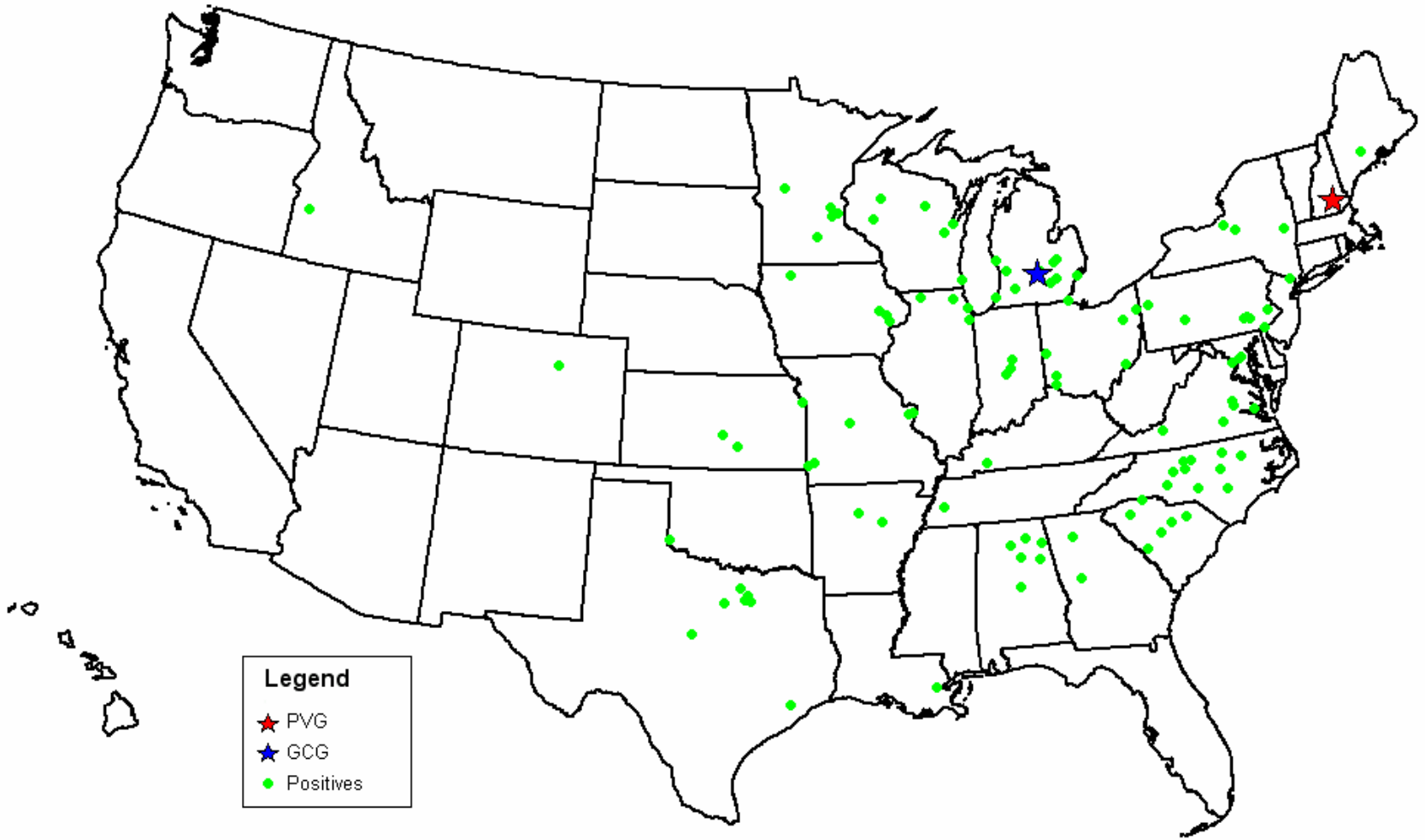

PVG and GCG Sites
Legend
PVG
GCG
GCG Customers
PVG Customers
814 Sites

R3B2 Positive Sites



Industry Initiatives

Geranium Bacterial Disease Control Initiative Group*

- 2001
  - Ball FloraPlant
  - Fischer USA
  - Goldsmith Plants, Inc.
  - Oglevee, Ltd.
- 2003
  - Dummen USA
  - Selecta First Class, Inc.
  - Fides North America

*Society of American Florists and the American Nursery and Landscape Association facilitated

Geranium Bacterial Disease Control Initiative Group

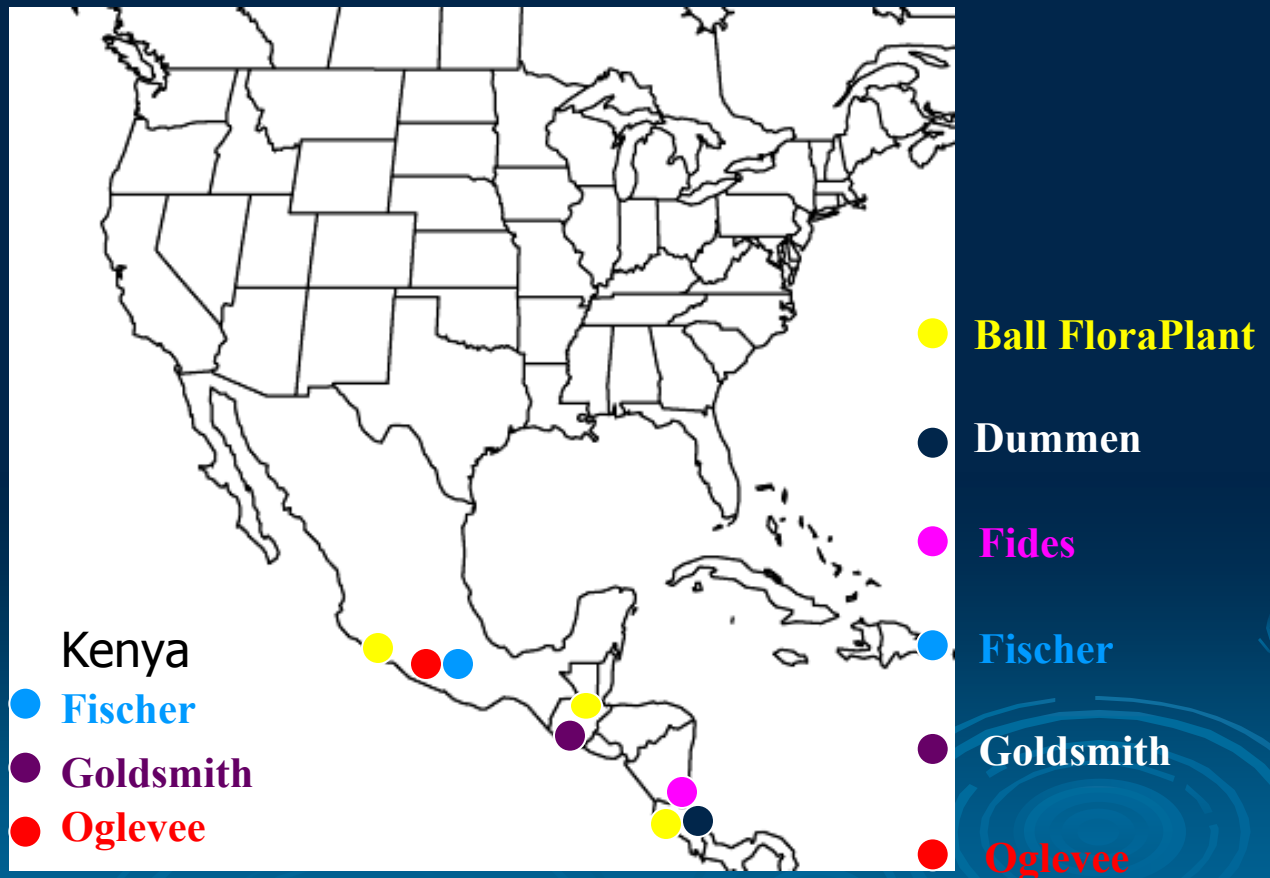
Goals:

- Improve clean stock protocols
- Support research
- Educate growers

Changes in progress by the offshore geranium production companies

Source: M. Klopmeyer, BallFlora Plant

North American Off-Shore Geranium Suppliers



Source: M. Klopmeyer, BallFlora Plant

Greenhouses

20,000 - 50,000
plants per section

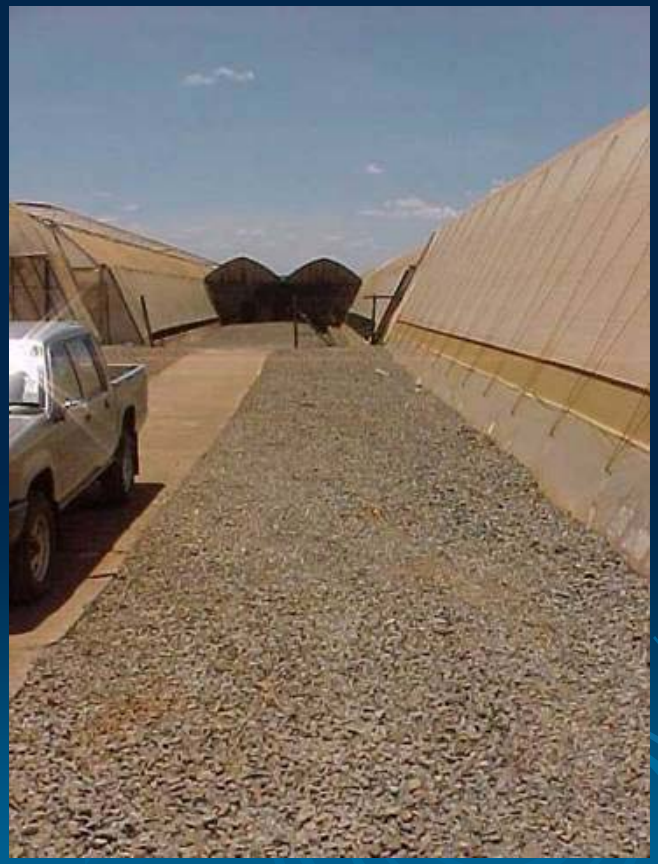
Source: M. Klopmeyer, BallFlora Plant

Production Greenhouse Specifications

- Concrete or gravel floors
- Raised benches
- Drip irrigation

Source: M. Klopmeyer, BallFlora Plant

Weed Control and External Water Barriers



Source: M. Klopmeyer, BallFlora Plant

Greenhouse Entrance

- Single or double door entryway
- Foot bath

Source: M. Klopmeyer, BallFlora Plant

Worker Sanitation

- Training
- Wash Station procedures
- Handwash with soap
- Hand disinfection

Source: M. Klopmeyer, BallFlora Plant

Worker Sanitation

- Lab coat / apron

Source: M. Klopmeyer, BallFlora Plant

Growing Media

- “Soilless” is norm
- Volcanic rock (scoria)
- Steam pasteurized
- Fumigation (Vapam)

Source: M. Klopmeyer, BallFlora Plant

Water Source

- Deep wells
- Pond/Lake only if treated first
- UV or chlorination
- Fertilizer injectors

Source: M. Klopmeyer, BallFlora Plant

Irrigation

- Bags for container
- Drip irrigation
- No subirrigation

Source: M. Klopmeyer, BallFlora Plant

Stock Plant Production

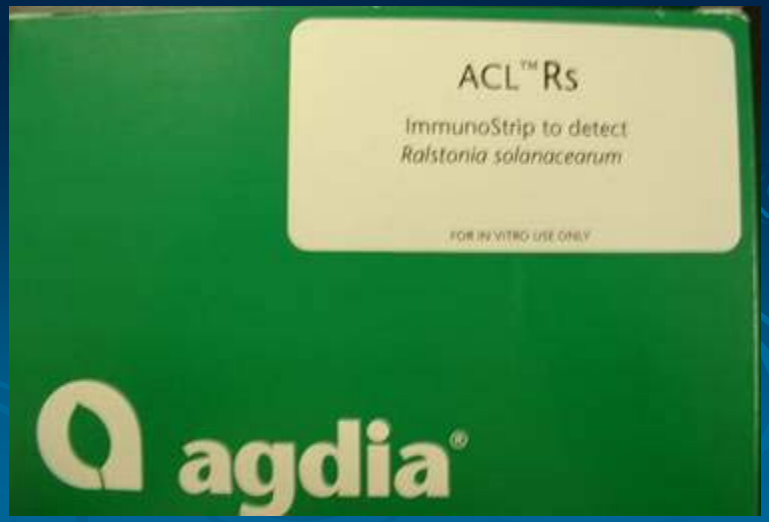
2-3 days from harvest to arrival at customer

Source: M. Klopmeyer, BallFlora Plant

Scouting and Testing

- Weekly scouting for suspect plants
- Weekly inspections by Ag authorities
- Weekly testing for Rs using CSL test
- Maintaining test records, traceback info for one year

Potato Brown Rot Pocket-CSL



Source: M. Klopmeyer, BallFlora Plant

Harvesting

- Knife disinfection
- Hand disinfection
- Clean bags/boxes
- Clean packing shed

Source: M. Klopmeyer, BallFlora Plant

Knife Disinfection

- Quaternary ammonia compounds
- Organic Acids
- Disinfected between each plant

Source: M. Klopmeyer, BallFlora Plant

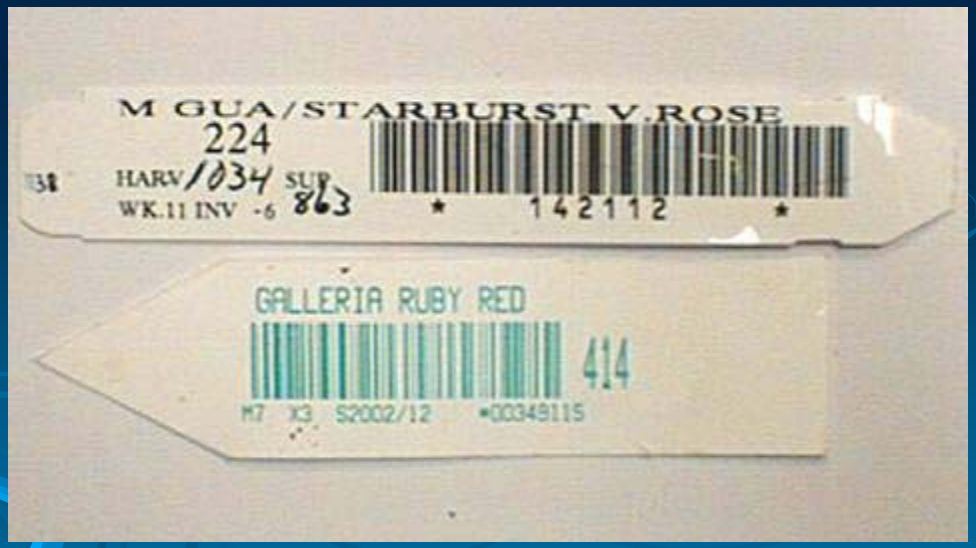
Pest / Pathogen Control

- Very active pesticide spray program
- Regular cleaning of production houses
- Annual renewal of stock at all levels
- Complete facility disinfection prior to new season

Source: M. Klopmeyer, BallFlora Plant

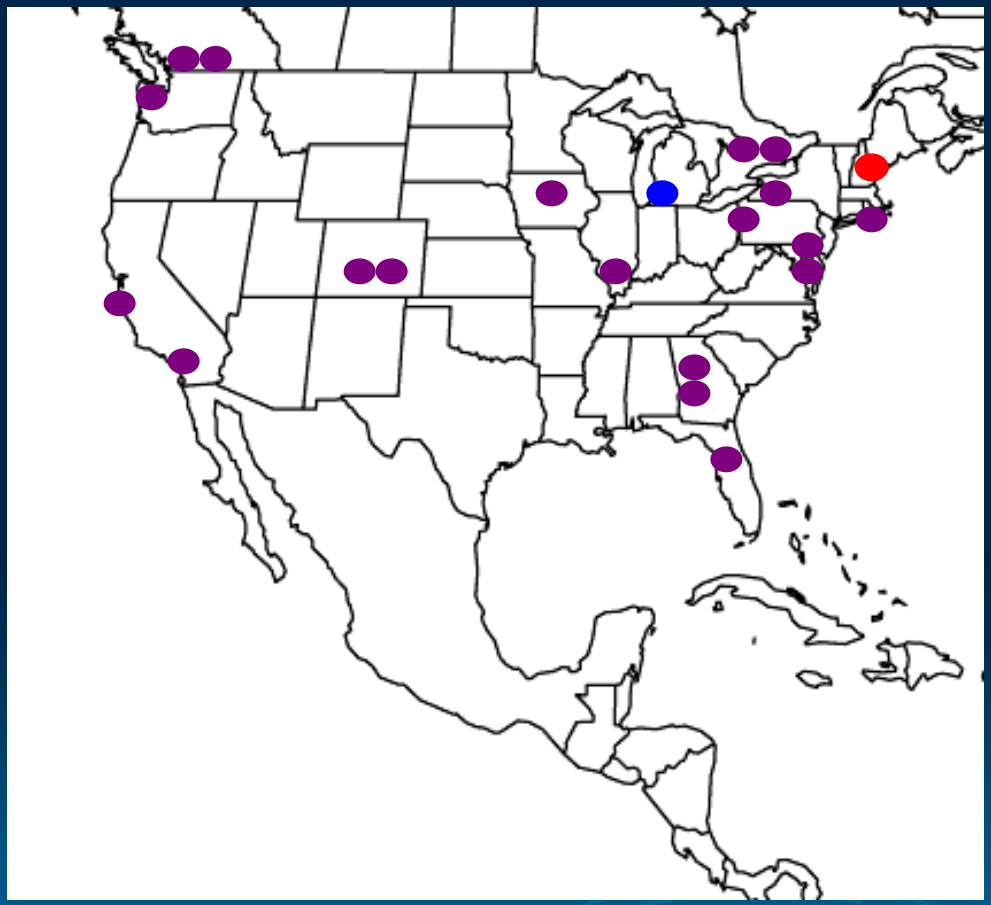
Trace Forward/Trace Back

- Quality Control tags
- Each bag of cuttings
- House, harvester, bench
- Rooted cutting trace



Source: M. Klopmeyer, BallFlora Plant

Geranium Rooting Stations



Source: M. Klopmeyer, BallFlora Plant

What can US growers do to help minimize the risk?

Do not use shared irrigation in growing geraniums, either in propagation or production. *Ralstonia* -- and many other pathogens -- spread very easily in irrigation water.

Keep crops from different shipments and different suppliers separated, during both propagation and finishing.

If producing stock plants, **disinfect cutting knives between each stock plant** (e.g. use a quaternary ammonium disinfectant) . Cutting knives are one of the most efficient ways of spreading bacterial diseases.

Scout crops often for signs of disease; have any problems checked out immediately.

Work with extension specialists, trade associations, and regulators to ensure maximum **knowledge** and use of most **current practices**.

June 17-19, 2003

- APHIS hosts a program review and a meeting to obtain input on future plans to address potatoes and tomatoes

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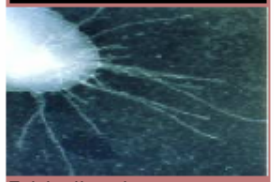
Wilting symptoms on geraniums caused by a destructive bacterial pathogen, Ralstonia solanacearum race 3 biovar 2, detected in US nurseries

Photo courtesy of the Wisconsin Department of Agriculture, Trade and Consumer Services

Ralstonia *solanacearum* race 3 biovar 2 is a bacterial pathogen not known to occur in the US. It causes a wilt disease in several important agricultural crops such as potatoes, tomatoes, peppers and eggplant. The disease it causes is known as Southern wilt, bacterial wilt, and brown rot of potato. This pathogen was detected early in 2003 in some US greenhouses that received imported geranium plants, and was subsequently eradicated.

Ralstonia Menu

- Ralstonia 2003 Program Review Meeting Summary (Best viewed in Internet Explorer)
- 2003 USDA Action Plan
  Action Plan Addendum
- Pest Data Sheet -CPHST
- Fact Sheet
- Image Gallery
- Links



Ralstonia solanacearum bacterium
Photo courtesy of: *Jacques Vasse, Centre National de la Recherche Scientifique*

Internet

USDA APHIS
Plant Protection and Quarantine

Ralstonia solanacearum **race 3 biovar 2**

[Program Review Meeting]
June 17 and 18, 2003
An assessment of the PPQ response to the 2003 Rs r3b2 outbreak in the United States.

[Action Planning Meeting]
June 19, 2003
A review and discussion of current scientific and operational issues in preparation to develop an action plan to eradicate Rs r3b2 in other crops.

Rubens Peale with a Geranium
Rembrandt Peale, 1801
National Gallery of Art
Washington, DC

Summary of Meetings [HTML] [PDF]
Participant List [HTML] [PDF]

Acknowledgements

Joel Floyd, PPQ

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Questions?